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PERCH (*Perca fluviatilis* L.) IN THREE IRISH LAKES.

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23.

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Introduction.

In May, 1950, a scheme for the reduction of coarse fish was inaugurated in two lakes, Lough Glore, County Westmeath, and Lough Rea, County Galway. A third lake, Barnagrow, County Cavan, was included in the scheme in March, 1951.

The area of Lough Glore is 87 acres and it has a pH of 7·5 (see Table 1 (Appendix) for analyses). The dominant plant of the shore vegetation is a reed (*Phragmites* sp.). It is a shallow lake. Its greatest depth is 30 feet with an average depth of approximately 12 feet. The bottom is marly throughout. A great variety of plants is found in the lake—the following being very numerous :—

(*a*) those with floating leaves, e.g., *Lemna minor* (L.), and *Lemna trisulca* (L.) ;

(*b*) those with emergent leaves, e.g., *Phragmites* sp., *Sparganium* sp., *Apium nodiflorum* (Reichb. fil.), *Hippurus vulgaris* (L.), and *Potamogeton natans* (L.) ; and

(*c*) those with submerged leaves, e.g., *Myriophyllum verticillatum* (L.), *Elodea canadensis* (Michx.), *Potamogeton pectinatus* (L.), *Potamogeton crispus* (L.), *Ceratophyllum demersum* (L.), *Chara vulgaris* (L.), *Nuphar* sp. and *Fontinalis* sp.

It has one large affluent and one large effluent stream.

Lough Rea, which is about one-and-three-quarter miles long, measures approximately one mile at its greatest width and has an area of 725 acres. It is highly alkaline, (Table 1) the pH being 8·4. It has two small affluent and two small effluent streams. The shores are rocky except for a few sandy bays with reed beds (*Phragmites* sp.) on the south-eastern and in a small area on the south-western shores. Extensive areas of the bottom are covered with large limestone boulders, whilst around the largest island—near the south-western shore—it is marly with a thick growth of calcified *Chara vulgaris* (L.). It is generally shallow, although at one point in the centre of the lake a depth of 120 feet is reached.

The area of Barnagrow Lake is 94 acres, and its pH is 6·8 (Table 1). The bottom is stony except for a small area where there is a dense growth of *Callitriche stagnalis* (L.) and *Ceratophyllum demersum* (L.). There are some reed beds (*Phragmites* sp.) on the south and south-western shores. It has two small affluent streams and one small effluent stream.

Material and Methods.

Most of the fish examined were caught by seine nets, but some of the larger ones were taken in gill nets which were set for pike. Each fish was placed in its appropriate length group (see Fig. 1), and the sex and the condition of the gonads

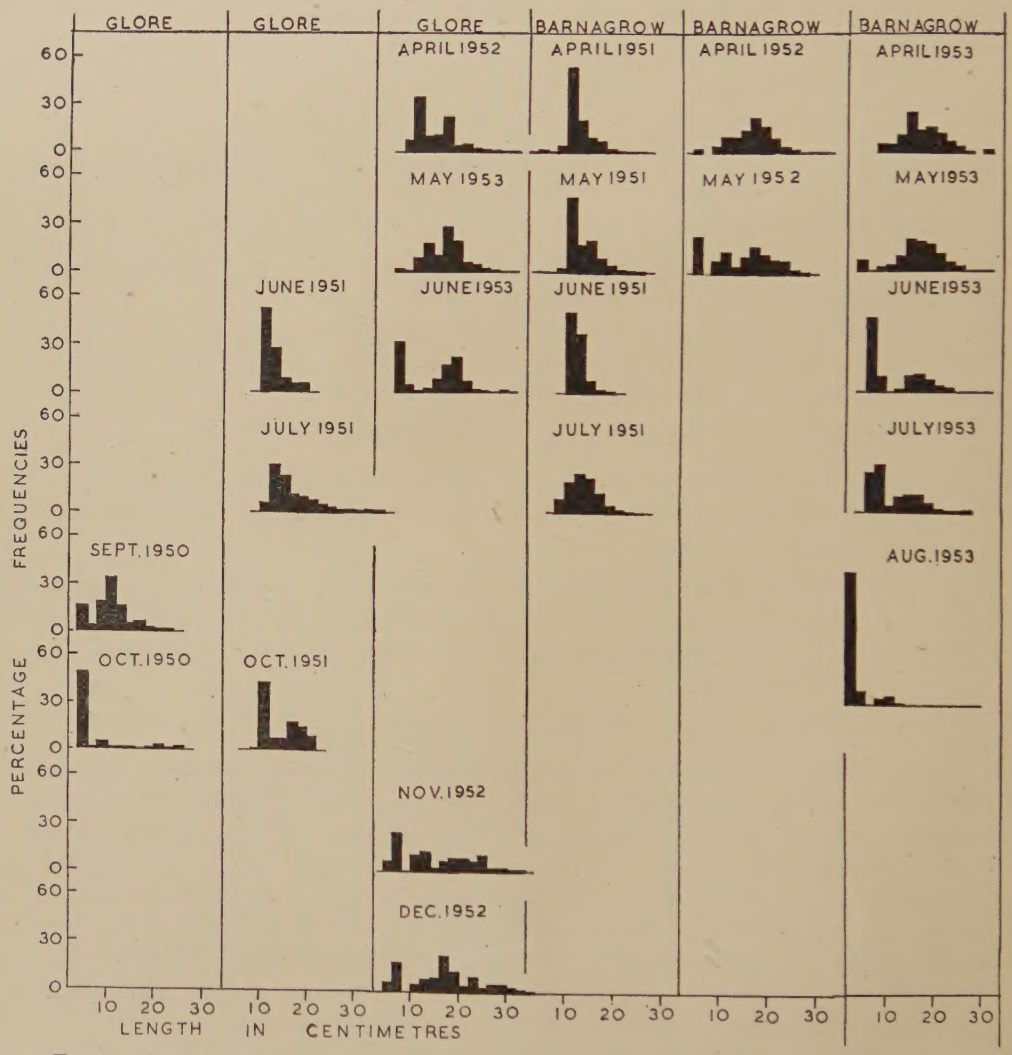

Fig. 1. *Length frequencies of perch in Lough Glore and Barnagrow Lake* (1950-1953)

was also noted. Subsequently, ten specimens from each length group were examined in the following way. Firstly, the length of the fish from the tip of the premaxilla to the distal end of the longest caudal fin ray was measured, and its weight recorded. Secondly, the left opercular was removed—in some cases scales were taken also. Finally, the stomach was removed and the contents preserved. In the spawning season some ovaries were extracted and preserved.

The age of each fish was determined by reading the left opercular bone. The bones were placed in warm water for a few minutes, and were then easily cleaned. The operculars were read by means of an inverted projector and polarized light. The " centre " was determined at the point where the opposing margins of the bone met (Le Cren, 1947). The distance between the rings was measured in the usual way. As the first so-called " winter " zone was laid down before the fish was a year old, it was placed in the O-group, and a fish was not considered to be in the I-group until the second zone was formed. (Le Cren's grouping is, therefore, one in advance of the writer's). Apart from the first so-called " winter " zone, which is not readily identifiable, all the others are fairly clearly defined.

Spawning Habits and Seasons.

The males enter the spawning beds before the females. When operations commenced in Barnagrow Lake (mid-April 1952) an inward migration to the spawning grounds was noticeable. Of the fish taken from 16th to 20th April 88 per cent. were males. Spawning, which occurs here in late April, took place in the weeds in the shallows. In 1951 and 1952, the first spent females were netted on 24th April, and in 1953 on 23rd April. When netting was resumed in Lough Glore on May 12th, 1952, and May 14th, 1953, all the females taken were spent. Hence, it would seem that spawning takes place in these lakes at an earlier date than that mentioned by Hartley (1947) for East Anglian waters, where the first spent females were taken on June 9th, 1939, and June 11th, 1940.

Age at Sexual Maturity.

Amongst the males, 90% of the I-group and all those in the II and older groups, were sexually mature in Barnagrow Lake. Eighty-eight per cent. of the males in the I-group and all older fish were mature in Lough Glore. Of the females, 9% of the I-group, 64% of the II-group, and all those in the III and older groups were mature in Barnagrow Lake. In Lough Glore, 5% females of the I-group, 53% of the II-group, 98% of the III-group, and all older fish, were mature. From these results it would seem that the females in Barnagrow Lake mature a little earlier than those in Lough Glore. Hartley (1947) found that 80% of the I-group males, 92% of the II-group, and all those in the III and older groups were in breeding condition in East Anglian waters. He found no breeding fish amongst the females in the I-group and of the II, III and IV groups, 77%, 80% and 71%, respectively, were mature. Thus it is evident that in East Anglian waters both males and females mature later than in the Irish lakes under review.

Length Frequencies.

As may be seen from Fig. 1, the 10–12 cm. length group predominated in Barnagrow Lake in April, May, and June, 1951, and in July of that year these fish had presumably reached the 12–14 cm. stage. In April, 1952, this group had possibly become the 16-18 cm. group, and in May of that year a new length group predominated the 4–6 cm. group. Another new length group predominated in April and May, 1953 (14–16 cm. group). In June the 6–8 cm. length group was most frequently present, and in July these had possibly reached the 8–10 cm. stage. Another new length group predominated in August the 2–4 cm. group.

Age and Growth.

A total of 2,456 operculars and 398 sets of scales from Lough Glore, 3,266 operculars from Barnagrow Lake, and 319 operculars from Lough Rea, were examined, and the proportion of fish in the different age groups for the years under review is given in Table 2. In 1950 and 1951 the I-group predominated in Lough Glore. The II-group predominated in 1951 and 1952 in Barnagrow Lake, and in 1952 and 1953 in Lough Glore. In 1953, the O-group predominated in Barnagrow Lake.

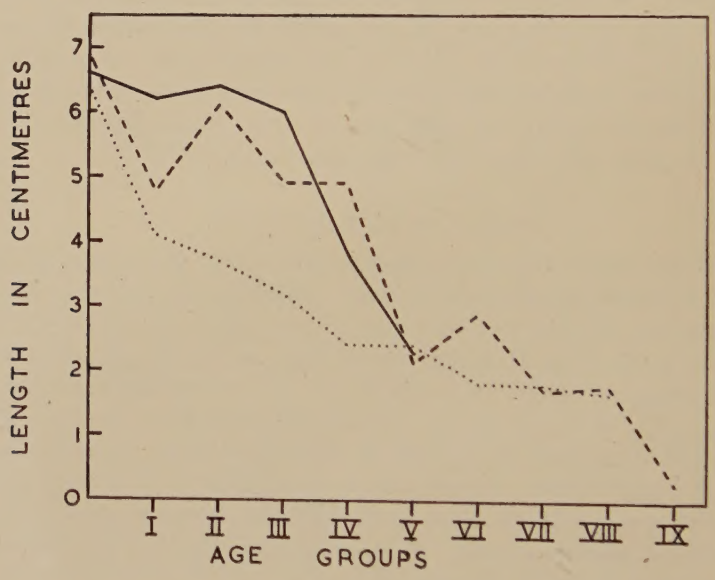

Fig. 2. *Mean incremental growth for the three lakes. Full line, Lough Rea; broken line, Lough Glore and dotted line Barnagrow Lake.*

A comparison of the calculated lengths of fish in Lough Glore from opercula and scales for 1950 is given in Table 3. There is a discrepancy of two centimetres in the lengths calculated from the opercula and scales in the I-group. Ambiguous ring formation in the scales may be responsible to some extent for this, and opercula were, therefore, used for later growth calculations. From the three lakes 1,309 opercula were examined in 1951, 1,379 in 1952, and 2,976 in 1953. The calculated lengths are given in Table 4. These may be compared with the growth rates of perch from some English and Continental waters, as determined by scale reading (Table 5). Generally speaking, growth is more rapid in Lough Rea than in Lough Glore or Barnagrow Lake after the first so-called " winter " zone is laid down on the opercular. The growth rate in Lough Rea, generally, is also superior to that in waters mentioned by Hartley (Table 5). Growth is markedly less in Barnagrow Lake than in Lough Glore or Lough Rea, except in the case of the O-group.

The average incremental growth is generally greatest in the O, I, and II groups (see Fig. 2 and Table 6).

There is evidence that the so-called " winter " zone in the opercular is laid down in September/October in Lough Glore because many opercula taken then showed such zones on the edge, while some opercula taken in late October showed so-called " summer " growth outside these " winter " zones. All opercula taken in November, 1952, had " summer " growth on the outside, but very little growth seems to take place during the period November–May, particularly in the III and older groups.

Calculated Age Distribution.

A rich year class was found to be dominant during a long sequence of years by Alm (1951) in Swedish lakes of dystrophic type studied by him, and he also found that new rich year classes arise often in eutrophic lakes. All monthly length group samples from Lough Glore and Barnagrow Lake were put into their respective age groups with a view to comparing their age distribution (see Fig. 3). It may be seen that the I–group predominated in Barnagrow Lake in 1951, the II–group in 1952, and the III–group in April and May, 1953. In June and July of that year a new rich year class, the O–group, appeared.

The I–group was most frequently present in Lough Glore in 1951. As the I–group also predominated in March–April, 1952, it would appear to be a new rich year class. In November–December of that year this group becomes the II–group, which group also predominated in May and June, 1953.

From these results it would appear that one year class predominated in Barnagrow Lake from April, 1951, until May, 1953, whereas two year classes predominated in Lough Glore over the same period.

Sex Ratio.

During the years under review, 21,166 fish were sexed and 46% were found to be males. The males are generally more numerous in the lower age groups, and the females in the higher groups. Roper (1936) found that the number of females

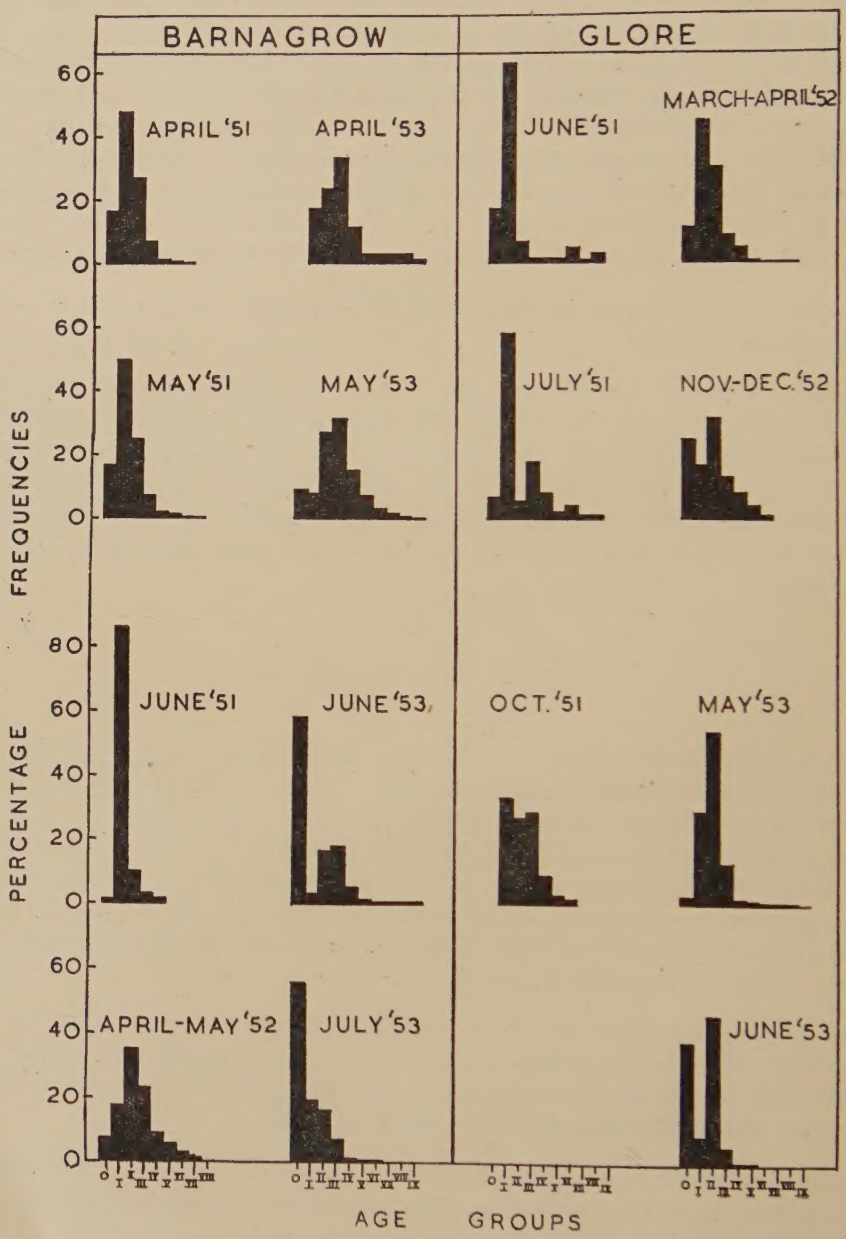

Fig. 3. *Calculated age distributions in Lough Glore and Barnagrow Lake.*

became increasingly greater in the III and older groups, but he observed, also, that in the younger age groups the proportion of males to females was approximately the same. Hartley (1947) records that of 72 fish from East Anglian waters examined by him in the III and older groups, 53% were males. Alm (1951) found that amongst spawning fish, the males were in the majority in the smaller length groups and the females in the large length groups.

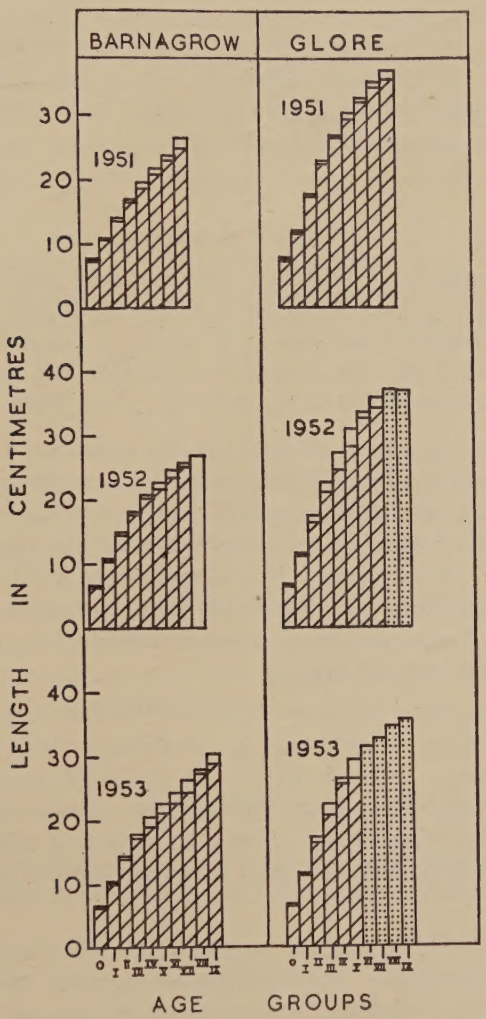

FIG. 4. *Growth differential in the sexes from Lough Glore and Barnagrow Lake* (1951-1953). *Where the males differential is superior in length to the females the differential has been indicated in black and where the reverse is the case in white. The dotted areas are females only (no males of these age groups being available).*

Growth Differential of the Sexes.

Alm (1951) has pointed out that males grow less rapidly than females in the Swedish lakes studied by him. He found that the difference was slight in dystrophic lakes. In Windermere (1943) growth for the first two years was found to be rapid for both sexes, and thereafter it slowed down, and the females grew rather more rapidly than the males. The calculated lengths of the males was a little greater than that of the females in the O and I groups in Barnagrow Lake in 1952 and 1953, and in Lough Glore in 1951, 1952, and 1953 (see Fig. 4). For the II and older groups in both lakes the calculated lengths of the females are slightly greater than those of the males. The greatest difference being 3 cm. in the IV and V groups for 1952 in Lough Glore and the V–group in 1953. In Barnagrow Lake the greatest difference was 2 cm. in the VII–group in 1952.

Stomach Contents.

The stomach contents of 3,849 fish were examined, and the percentage of fish containing each type of food organism is shown in Tables 7–9. Almost all fish up to 26 cm. in Barnagrow Lake, and up to 24 cm. in Lough Glore fed on plankton. Southern (1926) records that the crustacea of the plankton form an important part of the food supply of perch and of perch fry in Lough Derg.

In Lough Glore, *Gammarus duebeni*, *Asellus aquaticus*, and *Chironomid* larvae and pupae, are eaten freely by perch in practically all size groups in summer. There is a noticeable absence of *Asellus* sp. in May and June, 1953, which food seems to be replaced by *Odonata* nymphs. *Gasterosteus aculeatus* was present in the 12–14 cm. perch in each year. *Chara vulgaris* (L.) was found in 51 stomachs, *Hirudineae* in 80 and *Mollusca* sp. in only 32, though the latter are very abundant in the lake. *Chironomid* larvae, *Asellus aquaticus*, *Gammarus duebeni*, and plant material comprise the bulk of the diet in winter.

From the perch taken in Lough Glore in October, 1951, 108 stomachs were examined. Ninety-six were examined in November, 1952, and a further 129 in December of that year. Of these, 40%, 26%, and 41%, respectively, were empty. During the period April–May, 1952, 189 stomachs were examined from the same lake, and 16% of these were empty. This is in agreement with Allen's observations (1935) that perch of all sizes had empty stomachs more frequently in winter than in summer.

In Barnagrow Lake in addition to plankton, *Chironomid* larvae and pupae, *Corixa* sp., *Gammarus duebeni*, and *Ephemeridae* nymphs comprise the bulk of the diet. Of 571 stomachs containing food examined in June, 1953, 309 in July, and 91 in August, 52%, 70%, and 72%, respectively, contained perch fry. Even large perch fry were found feeding on their smaller brethren during that period.

From Lough Rea, all stomachs containing food which were examined contained *Gasterosteus aculeatus*. In June, at any rate, the *Hirudineae* seem to play an important part in the diet there.

These observations do not agree with those of British, American, and Continental workers, except Nilsson (1921), who found that the food varies with the size of the fish. Allen (1935), in Windermere, found that fish less than 14 cm. fed on plankton, those between 14 and 18 cm. on bottom fauna, and those over 18 cm. on fishes. Roper (1936) records that in German waters one-summer perch fed on planktonic crustacea, perch of two summers—up to 15 cm.—on insect larvae, and those over 15 cm. on larger animals. Alm (1922) also found that in some Scandinavian waters small perch fed on the crustacea of the plankton, middle sized ones on insect larvae and other bottom fauna, and the largest perch on small fish. Nilsson (1921) was unable to find any variation in food with the size of the fish in the Scandinavian waters described by him. Couey (1935) examined the stomachs of 2,288 yellow perch (*Perca flavescens*) from some north-eastern Wisconsin lakes. He discovered three distinct food periods—1, when *Entomostraca* and small insect larvae are eaten ; 2, when insects are the major food ; and 3, when fish and crayfish are the chief foods.

Two perch from Lough Rea, seven from Lough Glore, and ten from Barnagrow Lake had free-living Nematodes of the group *Mermithidae* in their stomachs. This practice of fish taking free-living Nematodes seems to be fairly common in English waters.

Ova Counts.

Eleven ovaries were taken from the perch of Lough Glore in early April, 1952, and the number of ova in each ovary was estimated by the gravimetric method. The range of variation of ova per ounce of body weight of fish was 3,341 to 4,643 (95,000 to 132,000 per kilogram). The average number of ova per ounce of fish was 4,080 (116,000 per kilogram) which is greater than 3,108 (88,000 per kilogram) recorded by Pincher (1947). Pincher examined three ovaries, and the number of ova to the ounce of fish varied from 2,891 to 3,350 (82,000 to 95,000 per kilogram). His results were obtained by actual counts.

Parasites.

Ten perch taken from Lough Rea and numerous specimens from Lough Glore had in their stomachs specimens of *Acanthocephalus lucii* (Mull.).

Population Study.

A thousand fish from Barnagrow Lake, and one thousand five hundred from Lough Glore were tagged with silver wire which was inserted at the base of the dorsal fin. Petersen's formula (1897) P=AB/C was used to estimate the adult population

where B=total number of fish tagged; A=total number recaptured of which C were tagged. The estimated adult population for Barnagrow Lake was approximately 18,700, 77% of which was removed by the end of 1953, and that for Lough Glore was approximately 13,400, 53% of which was removed by the end of 1953. This amounts to 200 and 154 adult fish, respectively, per acre of water.

Summary.

1. A brief description is given of the three lakes from which the perch under examination were taken (Table 1).
2. Material consisting of operculars, scales, stomach contents, and some ovaries, together with relevant data, provided the basis for this investigation.
3. The opercular bones were considered more satisfactory than the scales for determining the age of the fish.
4. Spawning takes place in late April in Lough Glore and Barnagrow Lake.
5. In Barnagrow Lake 90% of the I-group males and all older fish were sexually mature, and in Lough Glore 88% males of the I-group and all older fish were sexually mature. The females mature later than the males.
6. One length group predominated in each of the monthly samples taken. (Fig. 1).
7. Growth is markedly less in Barnagrow Lake than in Loughs Glore and Rea (Table 4). The growth of the Irish fish is on the whole much faster than those of the British or Continental waters investigated to date (Table 5). The average incremental growth is greatest in the first three years (Table 6 and Fig. 2).
8. The so-called "winter" zone is laid down in September–October in Lough Glore.
9. One year class predominated over a three-year period in Barnagrow Lake, whereas two year classes predominated in Lough Glore over the same period (Fig. 3).
10. The males are generally more numerous in the lower age groups and the females in the higher groups.
11. The calculated lengths of the females were greater than those of the males except in the O and I groups (Fig. 4).
12. Feeding depends to a large extent on the available food supply, and the question of the size of the fish does not appear to be important (Tables 7–9).
13. The average number of ova per ounce of fish was calculated at 4,080 (116,000 per kilogram).

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TABLE I. ANALYSES OF WATERS FROM LOUGH REA, LOUGH GLORE AND BARNAGROW LAKE IN PARTS PER MILLION. (RESULTS FROM STATS LABORATORY, DUBLIN).

WATER	DISSOLVED SOLIDS.							
	Silica ($Si\ O_2$)	Phosphorus ($P_2\ O_5$)	Chloride (Cl)	Iron ($Fe_2\ O_3$)	Calcium (Ca O)	Magnesia (Mg O)	Sodium (Na_2 O)	Potassium (K_2 O)
Lough Rea	1.0	0.8	19.0	<1.0	51.6	8.3	17.0	1.5
Lough Glore	<1.0	0.2	13.0	<0.1	115.5	22.0	14.6	1.4
Barnagrow Lake	<1.0	0.4	17.0	<0.1	14.0	4.2	14.0	2.2

TABLE 2. NUMBERS OF PERCH EXAMINED IN THE DIFFERENT AGE GROUPS.

GROUP	LOUGH GLORE				LOUGH REA			BARNAGROW LAKE		
	1950	1951	1952	1953	1951	1952	1953	1951	1952	1953
0	156	6	136	102	84	2	4	256	89	406
I	176	92	117	308	5	4	52	242	155	263
II	39	78	167	470	8	13	50	295	227	330
III	7	62	86	260	17	5	20	179	149	295
IV	1	21	49	41	16	25	7	76	65	160
V	-	10	14	24	1	-	4	31	38	84
VI	-	11	6	3	2	-	-	5	18	42
VII	-	3	2	2	-	-	-	5	8	39
VIII	-	3	2	2	-	-	-	-	1	5
IX	-	-	1	1	-	-	-	1	-	2
TOTAL:	379	286	580	1213	133	49	137	890	750	1626

TABLE 3. GROWTH RATES OF PERCH FROM LOUGH GLORE (1950) CALCULATED FROM OPERCULARS AND SCALES

	AGE GROUPS.				
	0	I	II	III	IV
Scales	5.3	10.2	18.3	23.4	28.2
Opercular	6.7	12.2	19.1	23.6	30.7

TABLE 4. GROWTH RATES (IN CMS.) CALCULATED FROM OPERCULARS

Water	AGE GROUPS.									
	0	I	II	III	IV	V	VI	VII	VIII	IX
Lough Glore (1950	6.4	12.2	19.1	23.6	30.7					
do. (1951	7.4	11.6	17.4	22.3	26.6	29.9	32.5	34.9	36.4	
do. (1952	6.5	11.4	17.2	22.6	26.7	30.4	33.4	35.0	36.8	37.0
do. (1953	6.8	11.3	17.0	22.0	26.1	28.4	31.5	32.7	34.7	35.4
Barnagrow (1951	6.4	10.5	13.6	16.6	19.2	21.2	23.1	25.4		
do. (1952	6.4	10.6	14.7	17.8	20.4	22.3	24.4	26.0	27.0	
do. (1953	6.1	10.1	14.0	17.4	19.2	22.4	24.0	25.5	27.6	29.7
Lough Rea (1951	6.5	12.6	19.1	25.9	30.4	33.8	37.0			
do. (1952	6.4	13.0	20.4	25.9	30.1					
do. (1953	7.0	12.7	18.2	23.7	26.4	28.9				

TABLE 5. AVERAGE LENGTHS IN CENTIMETRES (REPRODUCED FROM HARTLEY 1947)

Water	Age in years.						
	0-1	1	2	3	4	5	6
Eastern England	5.7	8.6	10.9	14.5	16.5	16.0	-
Windermere	5.3	10.6	13.2	14.9	15.0	16.5	-
Lough Lomond	3.8	8.6	12.4	15.0	17.0	18.3	-
Hjarlamens (Alm,1917)	-	-	10.2	12.8	15.9	18.5	-
Kloten (Alm,1921)	3.8	7.1	10.2	12.2	13.8	16.2	-
Borgholm (Segerstrale,1933)	4.6	8.9	12.7	16.2	15.7	17.3	-
Vastervik(do.)	-	7.9	10.4	12.4	13.5	15.0	17.3
Mecklenburg)	7.1	9.0	10.2	11.2	12.6	13.4	14.8
Brandenburg)(Roper 1936)							

TABLE 6. AVERAGE INCREMENTAL GROWTH (IN CMS.) FROM OPERCULARS

Water	AGE GROUPS.									
	0	I	II	III	IV	V	VI	VII	VIII	IX
Barnagrow Lake	6.3	4.1	3.7	3.2	2.4	2.4	1.8	1.8	1.7	
Lough Glore	6.8	4.8	6.1	4.9	4.9	2.1	2.9	1.7	1.8	0.3
Lough Rea	6.6	6.2	6.4	6.0	3.8	2.3				

TABLE 7 (a). PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM LOUGH GLORE. MAY-JULY AND OCTOBER, 1951. (EMPTY STOMACHS ALSO INCLUDED)

Type of Food	CENTIMETRE LENGTH GROUPS														
	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40
Mermithidae								14					25	16	
Hirudineae							14	7			16		25	16	
Copepoda			50	7	15										
Asellus		6				12	28	15	20	14	33	25	75	-	100
Gammarus	18	12		53	31	44	71	38	80	43	66	25	100	33	100
Chironomid Larvae	18	17	33		25	25	28	23			16	25			
Caddis "		6	33		15	12	14	30	20	14	16				100
Chironomid Pupae	9		33		31	12	14	7							
Ephemeridae Nymphs		22	50	13	31	12	14	30	20		33	25	25		
Odonata "	18		33				28	15			16	25			
Perla "							14			14					
Corixa	18	6	33	53	15	26	43	23	10	28					100
Arachnida															
Pisidium							14	7	10	14		25			
Limnea		6					14					25		16	
Gasterosteus															
aculeatus		23		7	7	6	28	7	20		16			16	
Perca fluviatilis														33	
Unidentifiable Fishes		16			7				20		16	25		16	100
Plant Material									10						
Empty Stomachs	54	41		33	38	26	14	38	20	43	33				
Number Examined	11	17	6	15	13	16	7	13	10	7	6	4	4	6	1

TABLE 7 (b) PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM LOUGH GLORE, APRIL - MAY, 1952. (EMPTY STOMACHS ALSO INCLUDED).

TYPE OF FOOD	CENTIMETRE LENGTH GROUPS.																
	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40
Hirudineae									6								
Cladocera	40					5		7	13							50	
Copepoda	5																
Asellus		50	39	38	37	43		15	13	21	37	40			35	50	
Gammarus	5	100	28	50	26	62	41	46	26	51	42	50			33	50	
Chironomid Larvae	35								6		5	20			33	50	
Caddis "									6						33	50	
Chironomid Pupae	5		3	6	10	5	23	15	46	5	16	40	66		33		100
Ephemeridae Nymphs	5		3			5					5						
Odonata "			7	19	10	5	11	30	13	10	16	40				50	
Corixa			3	6	10	5	11				5	10			33		
Pisidium						5				5	5					50	
Limnea										5		10					
Snail eggs											5					50	
Gasterosteus aculeatus				6			11			5							
Plant Material							11		6	5							
Empty Stomachs	15		21		16	5	29	23	26	16	26		33	100	33	2	1
Number examined	20	2	8	16	19	21	17	13	15	19	19	10	3	1	3		

TABLE 7 (c) PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM LOUGH GLORE. NOVEMBER-DECEMBER, 1952. (EMPTY STOMACHS ALSO INCLUDED).

TYPE OF FOOD	CENTIMETRE LENGTH GROUPS.														
	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36
Cladocera	33		5	4				10							
Copepoda	14			4				10							
Asellus	4			20	15	42	7	10	12	6	10	20			100
Gammarus	6		11	28		18	15		19	12	20				
Chironomid Larvae	21		22	24	38	9	11	30	50	66	30	40	60	50	100
Caddis "	4		5				7	10		6					
Odonata Nymphs						3		10	6						
Theodoxus							11	30		25	20	20	40		
Lampetra											10				
Gasterosteus aculeatus						6	7	10							
Perca fluviatilis							4			6	10				
Salmo trutta										6					
Unidentifiable Fishes				4											
Plant Material			5	8	7	9	15	10	6	6			20		
Empty Stomachs	39		50	35	38	39	44	20	25		20	40		50	
Number Examined	48		18	25	13	33	27	10	16	12	10	5	5	2	1

TABLE 7 (d), PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM LOUGH GLORE. MAY-JUNE, 1953 (EMPTY STOMACHS ALSO INCLUDED).

TYPE OF FOOD	CENTIMETRE LENGTH GROUPS.														
	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36
Hirudineae	1		2	1	1	8	4	8	18	3	15	28	11		
Cladocera	64	82	61	54	41	30	27	14	3						
Copepoda	64	82	61	53	41	29	27	14	3						
Asellus			1		1			4	3	2	4				25
Gammarus	8	6	16	23	26	32	43	50	55	62	61	93	33	33	75
Chironomid Larvae	56	70	41	38	14	5	4	6	4	9		14	11		25
Caddis "	1	13	13	9	5	6	4	18	21	40	22	57	55		25
Chaoborus "		3	1												
Chironomid Pupae	9	9	7	10	6	6	6	10	13	7	15	33	22		25
Ephemeridae Nymphs	1	3	2	1	1	5	2	1	1	3			11		
Odonata "	4	6	27	30	43	59	53	52	44	32	35	14	22		25
Corixa					1	1	3	3	6	5	4			33	
Pisidium								1		2					
Limnea									1						
Theodoxus									3	5	8				
Planorbis										1					
Snail Eggs						1	1	1					11		
Lampetra							1								
Gasterosteus aculeatus				1	3	6	7	16	12	15	4	7	22	33	25
Salmo trutta							1								
Plant Material			1	1	4	1	3	1	5	5	8	7			
Empty Stomachs	14	6	6	4	9	5	3	1	7	15	8			33	
Number examined	74	33	102	133	141	149	149	133	100	53	26	14	9	3	4

TABLE 8 (a). PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM BARNAGROW LAKE. APRIL-MAY, 1951 (EMPTY STOMACHS ALSO INCLUDED)

Type of Food	CENTIMETRE LENGTH GROUPS											
	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32
Nematodes			6	7	20							
Cladocera	100	70	47	35	50	7	16	50				
Copepoda			13		10	7						
Asellus							35					
Gammarus				14	30		33	50				
Chironomid Larvae		20	33	28	40		16					
Caddis "			27	14	30	7						
Sialis "		10	20	14	20			75				
Chaoborus "			6		10							
Chironomid Pupae		90	94	69	30	7	33	75		50		
Ephemeridae Nymphs			13	14	20		16					
Odonata "			6									
Perla "				14	10							
Corixa				28	20	7		25				
Arachnida		10	6	7	20							
Plant Material			6	7								
Empty Stomachs		10	6	14		85	50			50		100
Number Examined	1	10	15	14	10	14	6	4		2		1

TABLE 8 (b). PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM BARNAGROW LAKE MAY, 1952 (EMPTY STOMACHS ALSO INCLUDED)

Type of Food	CENTIMETRE LENGTH GROUPS												
	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30
Nematodes			3	3	4					8			
Hirudineae									3	15	30	25	
Cladocera	19	60	31	3	26	36	26	17	32	27			
Copepoda	31	20	14	33	22	8	3	9	3	17	10		
Asellus			3			2	6	1		4			
Gammarus					6	25	22	29	39	65	50	50	100
Chironomid Larvae	44	60	14	37	38	52	46	36	50	23	30	50	
Caddis "			3		11	6	9	4	7	30	40	50	
Sialis "							1						
Chironomid Pupae	99	100	80	68	62	47	34	29	20	34	30		
Ephemeridae Nymphs			5	5	6	18	22	17	35	34	6	50	
Odonata "					6	2	4		14		10		
Corixa					4	6	12	14	28	30	50	25	50
Pisidium												25	
Empty Stomachs			8	15	6	4	10	17		4			
Number examined	16	5	35	39	45	44	64	64	28	26	10	4	2

TABLE 8 (c). PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM BARNAGROW LAKE. APRIL-AUGUST, INCLUSIVE, 1953. (EMPTY STOMACHS ALSO INCLUDED)

Type of Food	CENTIMETRE LENGTH GROUPS													
	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32
Hirudineae				2	3	5	4	10	14	6	11	6	20	
Cladocera	23	12	9	17	23	26	23	18	20	17	8	3		
Copepoda	20	14	9	16	20	22	21	17	18	14	3	3		
Asellus			1	1	1					1				
Gammarus	2	2	3	9	12	12	21	26	22	26	24	33	20	50
Chironomid Larvae	3	6	11	17	16	16	15	20	14	21	11	33		25
Caddis "	3	8	5	11	9	11	17	22	22	25	25	33	40	50
Tabanus "				1		1	1	1	1					
Donacia "					1				1	3	1			
Chironomid Pupae	6	7	12	14	14	12	11	7	12	6	6	5		
Ephemeridae Nymphs	28	16	11	8	4	11	12	11	5	8	4	3		
Odonata "			3	1	5	6	6	14	4	1	1			
Corixa	23	22	12	20	21	21	25	23	20	23	21	8	20	
Pisidium		1				1		1	1					
Limnea		1												
Theodoxus												3		
Perca fluviatilis(fry)	10	52	57	48	37	30	30	24	22	20	13	14	60	
Salmo trutta					1			1	1	1				
Plant Material			1	1	1		1	1		1	4			
Empty Stomachs	8	6	9	7	10	10	14	9	11	12	27	22	20	25
Number examined	60	183	209	178	158	199	185	167	135	110	62	36	5	4

TABLE 9. PERCENTAGE OF FISH IN EACH SIZE GROUP CONTAINING FOOD ORGANISMS FROM LOUGH REA. JUNE, 1952 (EMPTY STOMACHS ALSO INCLUDED).

Type of Food	CENTIMETRE LENGTH GROUPS							
	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32
Nematodes								
Hirudineae								28
Gammarus					50	58	100	43
Chironomid Larvae					16	14		28
Caddis "							100	
Chironomid Pupae						14		
Odonata Nymphs					16	28		28
Corixa					16	14		43
Limnea								14
Gasterosteus aculeatus	100	25				14		
Unidentifiable Fishes					50	85	100	43
Empty Stomachs		75						14
Number Examined	1	4			6	14 7	1	28 7